

One-component Metal Detector

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The principle behind a metal detector is really quite simple. The proof: this article, which demonstrates that a detector may be built in a jiffy from just one active component and easily accessible auxiliary items.

The design shown here is quite sensitive: depending on tuning, metal coins may be detected at a distance of 80-90 cms. As opposed to many other designs, the circuit shown here is relatively stable in respect of tuning and therefore easy to use.

Operation

Just as with many other metal detectors, this instrument employs the BFO (beat frequency oscillator) principle. A tone is produced whose frequency is the difference between a variable and a reference oscillator. In this circuit, a pocket medium-wave radio is used for the frequency reference. The variable oscillator in the detector is built around a hex (six-fold) Schmitt trigger inverter IC, the 40106B. The home-made detection coil is inserted between the input and the output of one of the gates in the 40106. Electronics textbooks will tell you that an inductor will oppose fast changes in an applied voltage. Looking at the circuit diagram shown here, any change in the logic level at pin 2 of IC1.A will be delayed before it is copied to input pin 1. This delay will cause the circuit to start oscillating, and the resulting

signal is inductively coupled to the antenna on or in the MW radio.

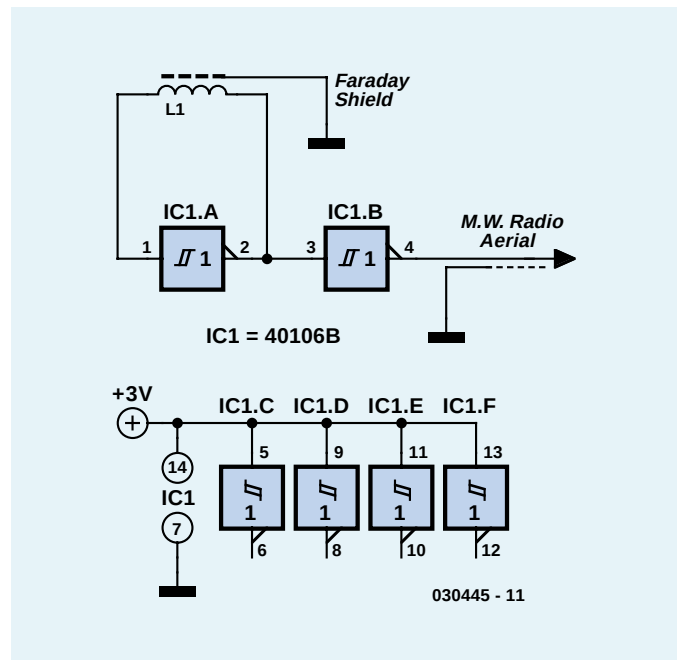
Although the MW radio will be tuned to a frequency that's much higher than the one generated by the 40106 gate, the BFO principle works equally well with oscillator harmonics.

If metal is present in the vicinity of the coil, the inductance of L1 will increase or decrease, causing the oscillator frequency to drop or rise respectively. This effect is made audible via the radio's loudspeaker.

Depending on the make of the 40106 you're using the oscillator will operate at 200-300 kHz. IC1.B is used as a buffer, ensuring that the oscillator only sees a light, fairly constant load and so guaranteeing that the output frequency remains stable (within limits, of course).

Coil winding

The detection coil consists of 70 turns of 0.35 mm diameter (28 SWG) enamelled copper wire on a former with diameter of 120 mm. The construction of the coil is not critical. As you wind,



the turns may be held together with small pieces of sticky tape. Once the winding is complete, the coil has to be fully isolated with electrical tape. Keep the two inductor ends free, however.

Screening and connecting

Next, the coil has to be screened using a couple of strips of thin sheet metal. First wind approximately 100 mm bare copper wire around the isolated coil. This wire will be in electrical contact with the screening later.

The metal strips are now fitted around the coil, covering the bare copper wire. Although the screening has to cover the full circumference of the coil, a small gap of about 10 mm has to be allowed for, in other words, the start and end of each metal strip may not touch. Secure the screening with electrical tape.

Next, connect the coil ends to the circuit by means of screened microphone cable of undisputed quality. The order of the connections is not important, as long as you make sure the coil screen is connected to the cable screen (braid) and the circuit ground. Of course, the detection coil may

be given a professional look and finish using, for example, a disc and a handle.

Detection

Pin 4 of the 40106 IC has to be connected to the radio by way of screened cable. If the radio does not have a separate antenna input, feed the metal detector output to the whip antenna by means of a small croc clip.

Switch on the metal detector power supply, then the radio, and select the MW (medium-wave) range. Tune the radio until a loud whistle is heard.

The detector can distinguish between ferrous and non-ferrous metals. The first will cause the frequency to rise, the latter, to drop. There's room to experiment with the oscillator output frequency. This is easiest done by raising the supply voltage (max. 15 V).

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